Information Network
For
Animal Productivity and Health
(INAPH)

INAPH at a Glance

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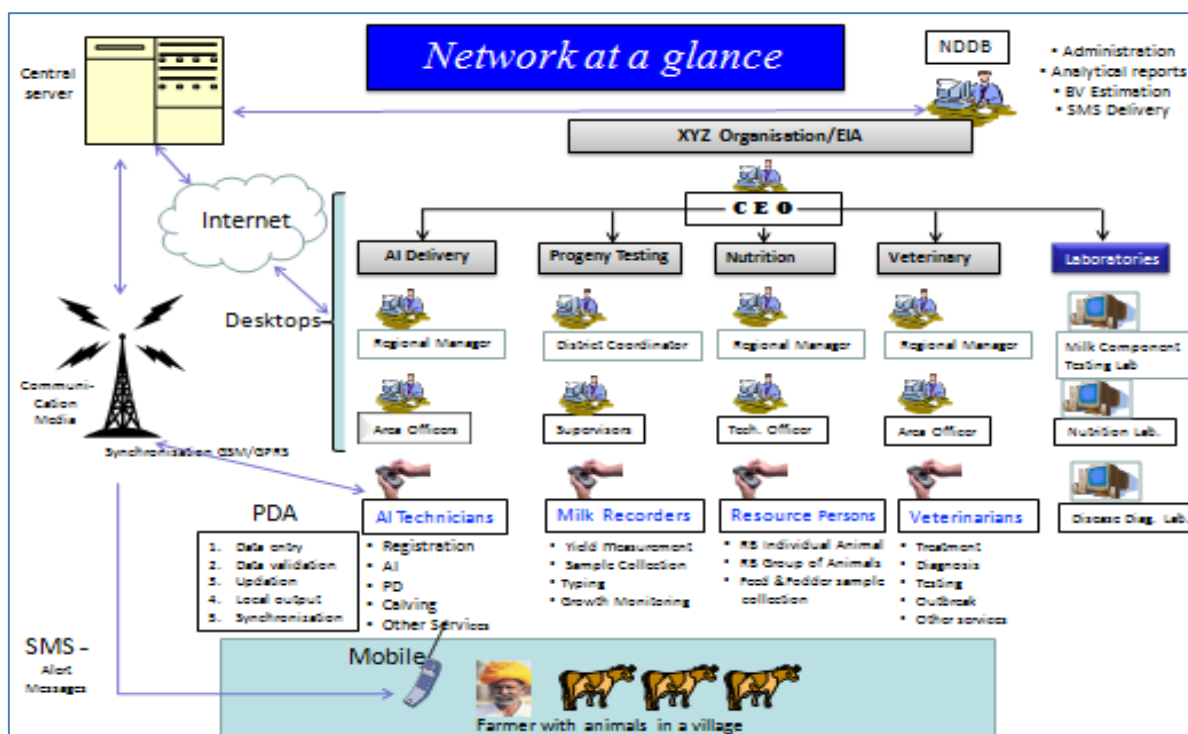R K Srivastava

1 Introduction

1.1 Besides building an infrastructure for making available quality semen, cattle feed, fodder seeds, vaccines etc. to farmers for improving the productivity and health of their animals, the modern tools of information technology and telecommunications are required to be welded with these services to provide reliable, easy-to-access and timely information to farmers, service providing organizations and policy makers for informed decision making at all levels.

1.2 NDDB has developed an information network in association with country's premier software development house, M/s Infosys Ltd. Bangalore covering all areas of productivity enhancement including animal registration and identification, artificial insemination, milk recording and progeny testing, ration balancing, health (treatment, diagnosis, testing, vaccination and outbreaks), advisory services and input supplies. It is planned to bring together all service providing organizations in the country and develop an industry level information network.

1.3 The information network is based on field force automation, using mobile technology (GSM or CDMA). Field force is provided with Handheld devices (PDA/Phone/Netbooks) to record activities (transactions) in real time with proper validation and generate information for monitoring & control of their daily activities at the village level. Field level workers synchronize their data (device) with the INAPH central server at Anand using GPRS services. The Web-based version of the Information network is available on desktop for entering data and generating information for supervisors, managers and other decision makers to help them analyze the past, monitor and control the present and plan for the future. The system also has facility to send SMS messages to farmers on their cell phones to alert them on what is due on animal(s) they have.

2 Objectives of developing the information network

The main objective is to make available to producers, productivity enhancement service providing organizations and others involved in the sector, information which can be used to improve productivity and health of dairy animals. Within this objective, other objectives include:

Network at a glance

- Make available an IT infrastructure to productivity enhancement service providing organisations and others involved in this sector.
- Record data on activities related to animal identification and registration, artificial insemination, milk recording and progeny testing, ration balancing and healthcare services.
- Give information support to technicians, supervisors and managers to monitor and control their field activities.
- Generate information for monitoring and evaluation of progress, making mid-course corrections, and planning of future activities.
- Develop a national level database on productivity enhancement related activities.
- Estimate Breeding Values of bulls & bull mothers centrally following a common estimation procedure.
- Achieve maximum participation of dairy producers, persons of service providing organizations directly in contact with farmers such as AI technicians, milk recorders, classifiers (typers), village resource persons etc. in data collection and encouraging them to use information produced by the network
- Promote participation of freelance private veterinary practitioners, nutritionists and farm consultants in data collection and making use of information
- Promote use of the central database
- Make the use of network for extension and education of farmers

3   Application USPs

The key distinctive features include:

- An Integrated application covering almost all key areas of the domain viz Animal Identification & Registration, AI Delivery, Genetic improvement programs (PT & PS), Animal Nutrition, Animal Health, Laboratory Analysis, Extension activities.

- A single database for all services and for all service providers, enabling analysis of impact of one service on the other.

- Designed to incorporate all processes based on existing scientific domain knowledge with minute details.

- A system containing a single application for all service providers ensuring uniform and standard logic for generating all parameters.

- It ensures uniqueness of Animal, Bull, Semen, Owner across country enabling tracking of Animals.

- Each & every activity is recorded individual animal-wise. A rigorous, uniform transaction validation mechanism is built in the system.

- It is capable of handling complex scenarios, where multiple agencies working in the same geography providing different services on the same animal.

4   Main services offered by INAPH

The main services offered by INAPH include:

Animal Identification and Registration: The main objective here is to identify and register animals each with a unique identification number.

Artificial Insemination and Natural Service: The main objective is to get female animals conceived as early as possible and reduce their inter-calving intervals.

Genetic improvement – Progeny testing and pedigree selection: The main objective is to improve genetic potentials of animals with respect to milk production, milk components such as fat, protein, lactose, somatic cell count, fertility, health and type characteristics.

Nutrition (Ration balancing): The main objective is to provide advice on ration balancing to exploit full genetic potential of animals.

Healthcare: The healthcare services include: treatment, diagnosis, testing, vaccination, de-worming, and outbreak reporting. The main objective is to keep animals healthy and fit.

Laboratory services: The laboratory services include: Feed and forage testing services, milk component testing services and disease diagnostic services.

Extension and Communication: The main objective is to enhance knowledge and skill of farmers on management of their animals

In each area the information needs have been broadly grouped into two categories:

1. Information for enhancing the effectiveness of individuals in carrying out their jobs
2. Information for enhancing their knowledge.

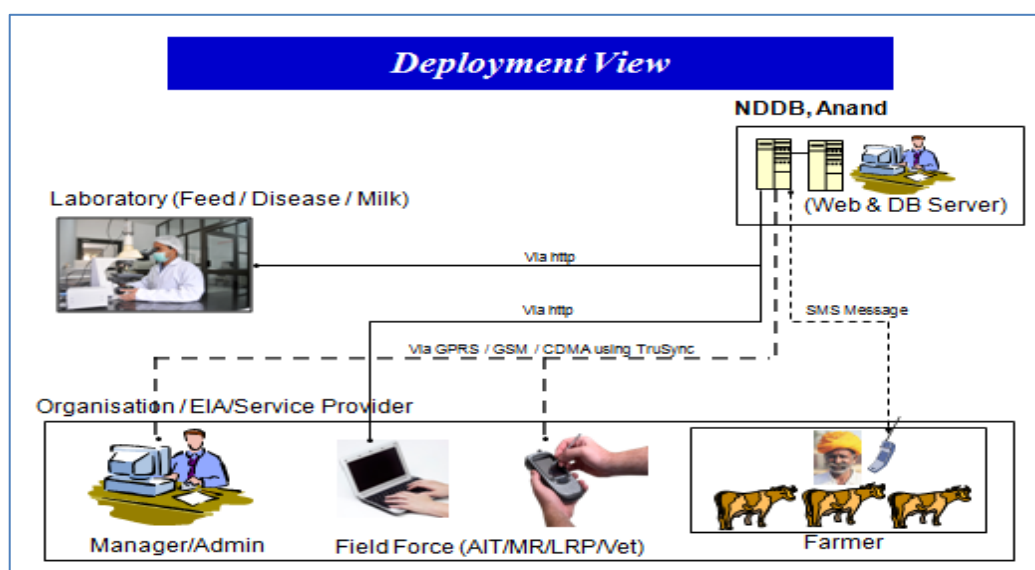## 5 Main users of INAPH

The main users of INAPH include:

1. Dairy Producers
2. Service providing organizations:
    a. Identification and Registration Services: State Governments, Milk Unions/Federations,
    b. Artificial Insemination Services: Milk Unions, NGOs, State governments, state livestock development boards, private AI service providers etc.
    c. Genetic Improvement Services: NDDB's partnering organisations implementing progeny testing programmes, state governments and livestock development boards implementing progeny testing programmes
    d. Semen stations
    e. Ration Balancing services: NDDB's partnering organisations implementing RBP, milk unions and federations, state governments and livestock development boards, NGOs etc.

  f. HealthCare Services: milk unions, state governments, private veterinary practioners etc.

  g. Milk Component Testing Services, Feed Testing Laboratories services, and Disease Diagnostic Services: all laboratories providing these services

3. Planners and decision makers: NDDB, state animal husbandry departments, livestock development boards, GoI etc.

6 System Architecture

The INAPH Network has been designed using **client-server architecture.** Reporting tools are web-based application on browser. The application has both online & offline versions. Different components of the network, working independently, are: (i) Admin Application; (ii) PDA Application; (iii) Desktop Main application; (iv) Laboratory Application; (v) Analytical Reporting Application; (vi) SMS Application; (vii) INAPH MIS Tool, and (viii) Database Synchronization Middleware.

The Admin application is a Windows-client application, which takes care of all administrative functions. It is an online application accesses the INAPH database server using http protocol or internet. It facilitates creation of an organization, allows the organization to select services and area of operation, creates users, field force hierarchy, reporting arrangement, allocates/de-allocates villages etc.. It defines role for different persons in the organisation for the services they opted. It creates all centralised masters like bull, semen station, test dose plan, AI centres etc. that are required for running the main application for different services.

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The **Desktop Main Application** is Windows-client application and has two versions one that works online accessing the INAPH central server using http protocol or internet and the other that works offline accessing the local database available on the client machine. The local database contains data related to specific user and it's area of operation. The Offline application synchronizes it's local database to the central server on regular intervals using sync middleware.

The Main Application contains all functionalities for capturing different transactions for all services, and producing outputs in the form of operational reports , review reports etc.

The **PDA Application** is a windows mobile based client application and works offline, accessing the local database available on the handheld device. The local database contains data related to specific user and it's area of operation. The PDA-Offline application synchronizes it's local database to the central server on regular intervals using sync middleware thru GPRS service.

The PDA Application has a subset of overall functionalities, primarily for field data collection, reporting requirements and alert messages.

The **Lab Application** is Windows client application, works online, and accesses the INAPH central server using http protocol or internet. The Lab Application is used by all laboratories, and takes care of all laboratory functionalities. It has three components (i) Milk component Laboratory, (ii) Feed and Fodder testing Laboratory, and (iii) Disease Diagnosis laboratory.

The **Analytical Report Application** is a web-based application that produces various analytical reports. A separate Analytical Database is maintained, populated from the central data base on a monthly basis to produce analytical reports.

The **INAPH MIS Tool** is a web-based application that produces various reports for monitoring and follow-up of field activities. It also facilitates export of INAPH database to other standard formats like excel, csv etc. for local use and analysis.

The **SMS Application** resides on the central server, accesses the INAPH database, uses rules and defined frequency and continuously broadcasts SMS messages to farmers' mobile. These messages are related to performance of their animals on an individual animal basis and the actions that they need to take on each animal.

The **Database Synchronization Middleware** is required for the offline applications either on desktops or handheld devices. The synchronization of   the local database with the server   database takes   place with the TruSync client component residing on the PDA and the TruSync component residing on the web server via wireless connectivity (GPRS, CDMA etc.). This synchronization is two way symc, server syncs local db and local db syncs server.

7   Tools and Technologies

The different technologies used include:
* Central Database Server – MS SQL Server 2008 R2
* Desktop/Netbook Client Applications – Windows based applications developed using .net framework.
* Handheld/PDA Client Applications - Windows mobile based applications developed using .net framework, SQL CE database along with IPMSS (Infosys proprietary mobile synchronisation solution)
* Web-based thin clients – Browser (Internet Explorer) based applications.

8   Unique Animal Identification System

The key points include:

* Animals are identified by 12 digit unique Ear tag numbers, as re-commended by ICAR(International Commettee for Animal Recording)

* First 11 digits of Ear tag number are running serial numbers, and the 12th digit is a check digit (Parity bit)

* Ear tagging with a unique number is a mandatory requirement for the use of INAPH Application.

* NDDB is centrally managing uniqueness of Animal Identification system by assigning numbers across the country

9   **Geography/Locations Identification**

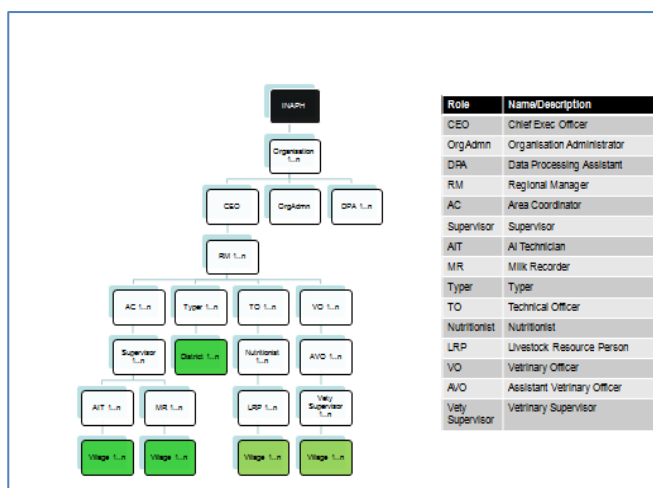The assignment of location is done as follows:

- GOI has prescribed four tier location hierarchy viz. State, District, Taluka & Revenue Village and uniquely identified all 6.5 lac approx revenue villages in the country.
- The INAPH Application uses the unique location identification system prescribed by GOI. It also has provision to capture hamlet/sub-village within a revenue village, if any.
- The INAPH application captures these unique location Identification codes with each transaction recorded in the system.
- The following of this location identification system enables the INAPH database to map with other databases of NDDB, GOI and other institutions.

10   **Users, their Roles, Hierarchy & Area of Operation**
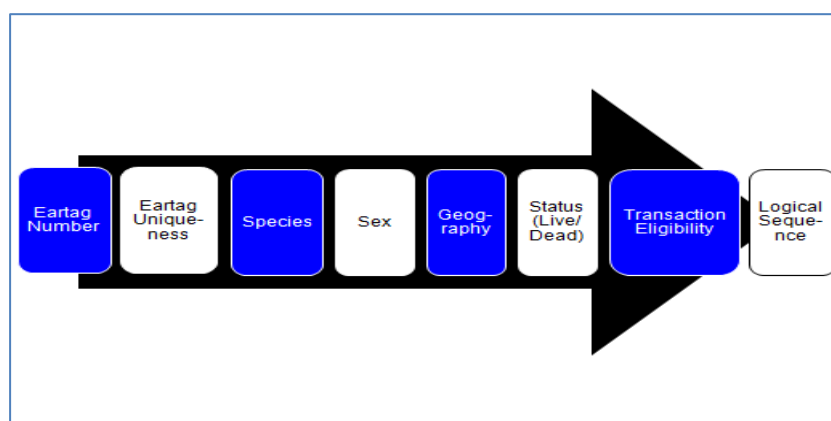
The key considerations include:

- Many service providers/ organisations can join the INAPH network and work simultaneously, even in the same area.
- Each organisation can create their field force hierarchy using 5 tier system available in the application.
- Users are grouped as per their roles in the system.
- Area of operation/locations are allocated/de-allocated to the lowest level user in the hierarchy.

11   **Activity Recording & Validation mechanism**

The key provisions made in the application include:

- The INAPH Application uses a robust validation mechanism at the time of recording any transaction in the system to ensure the quality of data.
- Each and every transaction passes through these validation checks. When all conditions are fulfilled by the transaction, then only the system allows to proceed.

- Few of the validation checks are as under.
    o The parity of eartag number: All twelve digits should be as per the identification system.
    o The uniquness of eartag number: Already registered animal with a particular eartag number cannot be registered.
    o Specie of the Animal: Specie conflict is checked; for example, buffalo semen cannot be used to inseminate a cow.
    o Sex of the Animal: Sex conflict is checked; for example males cannot be inseminated.
    o Geographic location of the animal: Animal's location is validated; for example an animal must be available in the area of operation (assigned villages) of the user. In case, physical movement of animal has happened due to purchase/sale then it should be recorded in the system properly through movement transaction assigning to a new location.
    o Status of the animal: The System doesn't allow any transaction against dead animals.
    o Transaction eligibility of the animal: The System validates the eligibility of the animal to receive the transaction against the present status. All domain related logical validation checks are carried out. For example, already pregnant animals cannot receive AI transactions, milk

recording cannot be allowed unless calving transaction is recorded, calving transaction cannot be recorded for non-pregnant animals etc.
- o Logical Sequence: For each and every animal, the system accepts transactions in chronological order only.

12   **INAPH Logical View (Modules & Functionalities)**

This section provides a brief description of different services/ modules and functionalities available in the INAPH application. The Transactions capturing UIs along with their attributes and related algorithms are explained. Different report classes and list of reports available in each class are explained.

The Windows Application on desktop/netbook contains all functionalities and reports, whereas the application on PDA/Handheld contains subset of functionalities primarily to capture transactions and generate operational reports.

The section provides a description for the following services:
1. Animal Identification & Registration.
2. Animal Reproduction (AI Delivery).
3. Milk recording (Progeny Testing & Pedigree Selection)
4. Animal Nutrition (Ration Balancing)
5. Animal Health Services
6. Laboratory Services
7. Stock Management

A brief description is also given on Analytical reports, SMS Application and Breeding value estimation application.

12.1   **Animal Identification (Registration) & Tracking**:

12.1.1   For the **Registration** of any animal in INAPH, it has to be identified applying a plastic ear tag with a unique number supplied by NDDB. The Registration transaction User Interface(UI) in the INAPH Application is divided into three parts: Animal related attributes such as specie, breed, pedigree, birth, calving, pregnancy status, milking status etc.; owner's details; and location details.

12.1.2   An animal is tracked in the system using Animal **Re-Registration** and **Movement** transactions available in the system. Each and every lag of the movement of the animal is recorded in the system. Incase, the eartag of animal falls due to any reason, a new eartag is applied to the animal using the '**Change Eartag**' transaction available in the system. All information of the animal attached to the old (lost) eartag is mapped to the new eartag to avoid any information loss.

12.2   **Animal Reproduction(AI Delivery)**:

         This module has three sub-modules: (i) Artificial insemination; (ii) Pregnancy diagnosis, and (iii) Calving.

12.2.1   By giving an animal tag number in the **Artificial Insemination** transaction UI, the system first does all validation checks, provides details of previous AI and allows capturing of data for the current AI like date of AI, bull number etc.. If the animal is inseminated first time after registration, the previous details of AI for that animal would be blank**. There is a mechanism in the Application to identify whether the AI is test AI or normal AI or nominated AI**. The AI technician can generate certain performance reports village wise, such as Animals not inseminated after calving (Open period > N days), heifers not pregnant and age > N months, list of non-pregnant animals by number of services, number of days after last service, number of services etc..

12.2.2   By entering an animal tag number, in the **Pregnancy diagnosis** transaction UI, the system first does all validation checks, provides details of previous AI and allows capturing of data for pregnancy diagnosis such as date of pregnancy diagnosis and result of pregnancy diagnosis. The AI technician can generate certain performance reports village wise, such as list of pregnant animals giving number of services, list of pregnant animals with pregnancy period etc..

12.2.3   By entering an ear tag number, in the **Calving** transaction UI, the system first does necessary validation checks, provides details of conception AI date and gestation period and allows entering of calving data, which include date of calving, calving type, calving ease and calf born details. All types of pregnancy termination like Single male, Single female, Twin(One male, one female), Twin both Male, Twin both Female, Stillbirth and Abortion can be recorded in the system. New born calves may be ear-tagged and system will automatically register these new animals in the database.

12.2.4   Regional Manager, Area Coordinators and in particular AI technicians can generate **Operational Reports** related to AI, PD & Calving. These reports can be generated village-wise containing animal ID, owner, sex, species, pregnancy and milk status and other relevant information. Operation Reports include: Animals not inseminated after calving; Heifers not attended; Animals due for PD; Animals to be dried off; Animals expected to calve, Calves born etc..

12.2.5   AI Technicians also get relevant **alert messages** on AI, Pregnancy Diagnosis and Calving using the PDA application.

12.2.6   All involved in providing reproduction services can produce performance review reports, which give number of AIs done, AIs followed, conception rates achieved, and calves born role wise or location wise (Village, Taluka, District, State) or Bull wise in each case going down up to village using the **AIMS Review Reports** functionality. The User can specify the duration and species for which review the report is required. These reports are meant for middle level managers to analyse and evaluate the past and plan for the future.

12.3   **Milk Recording and Progeny Testing:**

12.3.1   An animal is eligible for **Milk Recording** transaction after recording successful Calving transaction of an animal. By entering unique an ear tag number of the animal maximum eleven monthly milk recordings can be recorded in a lactation. The System maintains these milk recording transactions animal wise, for an animal lactation wise in the database. In each day's milk recording 3 recording (morning, noon & evening) are possible. Recording details are entered seperately for each time of recording. Milk quantity can be recorded in KGs or Ltrs, but it will be saved in KGs in the database. Necessary conversion is done by the system. While recording milk production, to avoid abnormal values and human errors, the necessary validation checks are made. The System displays previous milk recording details at the time of capturing transaction. Milk recording date, recording number and milk quantity are the mandatory fields in the UI.

12.3.2   Milk recording activity also includes activity related to **Milk sample collection** for milk component analysis. Milk samples are collected for analysis of Fat, SNF, Protein, Lactose, SCC, MUN. Milk samples are collected in the morning session only, hence Milk Recording UI in the system has provision to capture these details. The Sample collection data includes: Samplebox#, Samplebottle#, Testing Lab, testing charges etc.

12.3.3   In addition to milk production and sample collection details, **Animal Management** related data are also recorded along with each monthly milk recording. These management related data are: whether the animal has Hoof problem, being fed Mineral Mixture, has been Vaccinated against diseases, has been de-wormed, having Mastitis, animal's calf is live, calf is suckling etc.

12.3.4   An Animal is **Dried off** with a separate transaction, when milk production of the animal stops for the lactation. Dry off date and the reason is recorded as dry off details. Once the animal is dried off, no milk can be recorded for that lactation for the animal.

12.3.5   Using above monthly milk records, milk yields are estimated for 90 days, 150 days, 305 days (standard lactation), and total days, and other attributes like peak yield, milk days etc are also recorded. In addition, projected milk yield are also reported. Besides all parameters related to fat, SNF, protein, lactose, SCC, MUN are also calculated and stored animal wise.

12.4.   Another activity under progeny testing module is **Growth Monitoring** of calves. A separate functionality is available for capturing girth and length of calves for calculation of body weights of calves at regular intervals. Using these weights, growth rates at 6 month, 12 month and 18 month are estimated. Standard growth rates for different breed/species are used for comparing and monitoring growth rates of calves.

12.5.   **Typing** is another activity under progeny testing module of the system. This transaction can be recorded for any heifer once in a lifetime. Scores in the range from 0-9 are recorded for all 16 identified linear traits. These scores are used for estimating breeding values of bull/dams for these conformation traits. The conformation traits included are:
1. Stature
2. Chest width
3. Body depth
4. Angularity
5. Rump Angle
6. Rump Width
7. Rear legs set
8. Rear legs Rear view
9. Foot Angle

10. Fore udder attachment
11. Rear udder height
12. Central Ligament
13. Udder depth
14. Teat placement Rear view.
15. Teat Length.

12.6.   Managers, supervisors and in particular Milk Recorder & Typers can generate **Operational Reports** related to AI, PD calving, Milk Recording, Typing, growth Monitoring on PDA and Desktop. These reports can be generated village-wise containing animal ID, owner, sex, specie, pregnancy status and milk status and other relevant information. Operation Reports include: Animals under milk recording; Completed Milk Recording; Milk Recording schedule; Production performance of an animal; Heifers due for typing; Average milk production of a village etc..

12.7   Milk Recorders and Typers also get relevant **alert messages** for milk recording, and Typing of animals on their PDAs.

12.8   All involved in providing progeny testing services can also produce performance review reports which give number of Test AI done, Test AI daughters born, daughters followed up, daughters pregnant, daughters conceived, daughters calved, daughters completed milk recording etc. This information can be generated location wise, bull wise, role wise, specie wise etc. in each case going down up to village using the **PT Review Reports** functionality. User can specify the duration and species for which report is required.

12.4   **Animal Nutrition (Ration Balancing):**

Ration balancing and feed Sample collection form part of Animal Nutrition Services. Farmers need information on what to feed to their animals. They would like to utilize their available resources and know what should be supplemented while utilizing their resources to provide balanced nutrition to their animals.

12.4.1   **Ration Balancing**

This program aims at providing ration balancing advisory services to farmers by AI Technicians/ Milk Recorders/Village Resource Persons/Nutritionists/Veterinarians etc.. The programme has two parts: one provides the least cost ration for an individual animal, and second provides least cost rations for a group of animals.

For the individual animal ration balancing programme, it estimates the requirement of the animal in terms of nutrients such TDN, CP, Calcium, Phosphorus etc. based on growth and production parameters, and compares the requirement with the ration fed to the animal in terms of surplus or deficiency of nutrients fed. It then calculates the least cost ration based on the requirement of the animal and the availability of feed and fodder resources with the farmer.

Similarly, for a group of animals, it estimates the nutrient requirement of each animal separately and compares with what is being fed to each animal to assess the surplus or deficiency of nutrients being fed to each animal. After this, it calculates a least cost ration for each animal for all animals together meeting the nutrient requirement of all animals taking into account the availability of feed and fodder resources with the farmer.

To arrive at the least cost formulation, a Linear Programming approach is used. It uses a Simplex method is used to arrive at the least cost solution. The Objective function is set to minimise the total cost of ration, fulfilling the given constraints.

A Printed output of ration balancing is given to farmers whether animal is registered or not. **All calculations in the program are done on the dry matter basis,** although the user receives the solution on as such basis.

The steps involved in arriving at Individual Animal Balanced Ration include:
- Collect Animal profile information
- Determine nutritional requirements of the animal based on above profile.
- Capture current feeding pattern and calculate deficiency/surplus nutrients
- Generate the balanced least cost ration

12.4.2 **Feed Sample Collection**

AI technicians, Milk Recorders, Village Resource Persons, Veterinarians, Typers are the users who collect feed sample and fill up the sample information on the PDA. Anybody can send feed sample for testing. Sample Ids are generated by the System and are pasted on the physical sample for identification. The physical samples are then sent to the laboratory for testing. The feed testing Lab tests the composition of the various feeds/ fodder/ vegetation sent for testing. Results are recorded and updated, using the INAPH Laboratory Application on desktop by lab technicians.

12.5   Animal Health Services

This module helps in documenting major activities and interventions carried out in animal health area through user friendly UIs. The recordings can be carried out at two levels, namely (i) individual - based on tag number and (ii) mass (number of animals, species etc). The sub modules are separate for these two activities.

12.5.1   Animal Health Sub modules for individual recording

The recording of activities in these sub modules require the entry of a Unique Identification Number (UIN)/ tag number of the animal. The various sub modules available are: (i)Treatment, (ii) Vaccination, (iii) De-worming, (iv) Disease testing, and (v) First aid.

12.5.1.1 Animal Treatment

Provisions are made in this module to capture symptoms observed, diseases suspected, medicines administered and details of samples collected for each case. Multiples cases could be opened for a single animal if required, and, multiple follow-up visits could be recorded for each of these open cases. Results of laboratory tests performed are also transmitted live.

12.5.1.2 Vaccination

Details of vaccines carried out on an animal are recorded. The type of vaccine, disease against which vaccination is being carried out, mode of administration, dosage, manufacturer details, batch number of the vaccine, cost recovered and receipt number can be recorded. The last vaccination date of the animal would also be displayed.

12.5.1.3 De-worming

The generic name of the anthelmintic used, its dose, manufacturer's name, cost recovered and receipt number can be captured here. Here too, the date of last de-worming is displayed.

12.5.1.4 Disease testing

Periodic testing of animals for diseases like TB, JD, brucellosis etc can be captured using this module. Results can be recorded on the spot. Clinical samples, if collected can also be recorded. Results of any previous tests done can also be displayed.

12.5.1.5 **First aid**

Any minor intervention like wound dressing, abscess cleaning etc. carried out on the animal can be recorded along with the details. The previous intervention, if any, would also be displayed.

12.5.2 **Animal Health Sub modules for mass activities**

These sub modules captures activities that are carried out on a mass scale and does not require unique identification of animals. Only the number of animals and the species in which the activity is carried is recorded. The various sub modules available here are: (i) Mass vaccination, (ii) Mass de-worming (iii) Group disease testing, and (iv) Outbreaks.

12.5.2.1 **Mass vaccination**

The village name and the species wise numbers of animals vaccinated is captured here along with the type of vaccine, the disease against which vaccination is being carried out, mode of administration, dose given, manufacturer details and batch number of the vaccine.

12.5.2.2 **Mass deworming**

Here too, the village name and species wise numbers of animals de-wormed is captured along with the generic name of the anthelmintic used, its dose, and manufacturer's name.

12.5.2.3 **Group disease testing**

This module is used to record testing carried out on bulk samples like pooled milk, dung etc. The name of the village is captured here along with the species in question. Results can be recorded on the spot. Clinical samples, if collected can also be recorded. Results of any previous laboratory tests done is also displayed.

12.5.2.4 **Outbreaks**

This sub module is used to record any disease outbreaks occurring in a village. It has the provision to capture details of the village, taluka and district affected, symptoms noticed, disease(s) suspected, date when first incidence was noticed, reporting date, species wise number of animals affected or dead. Sample collection details can also be captured. Interim reports can also be documented while following up on an outbreak where in addition to the above, the probable source(s) of infection and the action(s) taken to control the same can also be recorded.

12.5.3   **Health reports**

The various reports that are generated from the inputs provided help the user to plan, analyze and formulate strategies for an efficient health care delivery mechanism. The reports that are available fall into two categories namely; (i) Operational reports and (ii) MIS reports

12.5.3.1   **Health Operational reports**

There are seven operational reports; they are:(i) Animals due for vaccination, (ii) Animals due for de-worming, (iii) Female calves between 4-11 months due for brucellosis vaccination, (iv) Animals due for disease testing, (v) Villages due for mass vaccination, (vi) Villages due for mass de-worming, (vii) Health care details of the animal. These reports provide all the interventions carried out on animals like de-wormings, vaccinations, treatments given, samples collected and diseases diagnosed.

12.5.3.2   **Health MIS reports**

These are analytical reports that can be generated right from the village level up to the State. These reports help administrators in decision making and planning. There are 9 such reports, namely: (i) Vaccination coverage, (ii) Organization wise vaccinations done, (iii) De-worming coverage, (iv) Organization wise de-worming done, (v) Disease pattern- Shows the monthly occurrence pattern of diseases reported, (vi) Organization wise animals treated, (vii) Disease specific treatment efficacy- this report helps pinpoint the most effective treatment regimen for the disease in question, (viii) Laboratory report abstract, (ix) Outbreak report.

The organization wise reports provides a clear picture in terms of important activities like vaccination and de-worming carried out by various stake holders.

12.6   **Laboratory Services:**

12.6.1   **Milk Component Testing Laboratory**

The milk testing lab is to test and record the components of the milk samples sent by the Milk Recorder. Only the milk recorder can send milk samples to the Laboratory. He records the sample milk details, which he puts on the sample box and then sends this sample to the specified laboratory.

For all milk samples collected by the milk recorder transaction is recorded with the following data items for each animal: Animal ID,

date of recording, box number, and bottle number, the Laboratory to which the sample is to be sent. This transaction is referred to the milk component laboratory, while sending the milk sample box physically to the laboratory.

All sample boxes used in the program are uniquely identified. Sample box number is mentioned physically on each and every box used in the program.

At the laboratory end, the milk sample is analysed for fat%, SNF%, protein%, lactose%, somatic cell count and milk urea nitrogen. These data is added in the individual animal milk sample transaction received from the milk recorder. The updated milk sample transaction is forwarded by the laboratory to the central data server.

At the server end the transaction received both from the milk recorder with details of milk yields, other information and from the milk laboratory for milk component analysis are put together. Fields of milk recording transaction are updated using milk component analysis data to complete the milk recording transaction. The fields for each duration are: Milk Recording interval (duration in days), Estimated milk production, Estimated fat yield, Estimated SNF yield, Estimated protein yield and estimated lactose yield for the duration. These transaction data items are stored as such for each milk recording.

12.6.2 Feed Testing Laboratory

The feed testing Laboratory carries out proximate analysis of feed and fodder samples. The Results are recorded and updated, using the desktop Lab Application by the lab technician.

Anybody can send feed sample for testing. The AI technician, Milk Recorder, Veterinary, Village Resource Persons, Typer are the users who collect sample information. The Sample Ids are generated by the System and then are pasted on the physical sample for identification. The physical samples are then sent to the laboratory for testing.

A User Interface is provided on the PDA and Desktop in order to capture the sample information. There are many other people who can send the sample for testing e.g. a farmer or an institution can request for testing a sample. They may send a physical sample with the village name, analysis to be conducted and the name and location of the sender to the laboratory.

When a test sample transaction is received in the laboratory, it is followed up for testing within the laboratory. Provision is made in the system at laboratory end to allocate this testing work to any technician along with expected date of result delivery. When test results of any transaction is updated in the system, it is released from the list of due tests.

There are many analysis types with various tests. The User may request for multiple analysis to be done. Also the user may select any number of tests within any analysis.

12.6.3   **Disease Testing Laboratory**

This laboratory analysis various pathological samples sent by field veterinarians. The results of the diagnosis are recorded and updated by the lab technician using the Lab Application on the desktop.

From the main INAPH application, only a veterinarian can send samples for testing. This sample information is collected when he is treating a case and wants a laboratory diagnosis. He collects a sample and records the details, saves the information, the system generates a sample ID which he puts as a label on the physical sample and sends the sample to the lab for diagnosis.

Other than the Veterinary, some other organisations/universities may approach these labs for testing requests. In this case, the village, sample type, tests to be performed, the sender's name and location are to be recorded using the lab's desktop interface.
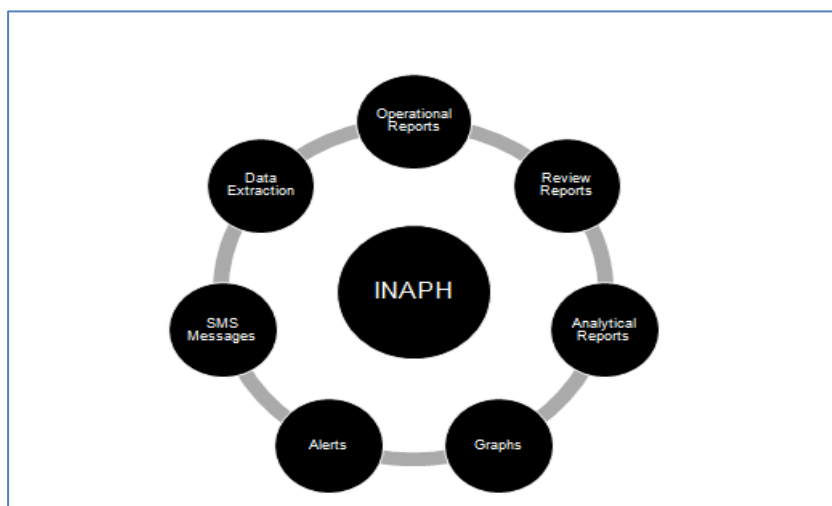
When a test sample transaction is received in the laboratory, it is followed up for testing. A provision is made in the lab application to allocate this testing work to any technician along with expected date of result delivery. When test results of any sample transaction is updated in the system, it is released from the list of due tests.

There are many types of samples for live and dead animals. Many types of examinations can be done on these samples. Hence, user may request multiple examinations on any sample.

13 **Reports & Outputs**

The INAPH application produces a variety of reports. There are 7 classes of information and in each class multiple reports are available. Reports and outputs have been designed considering the information requirements of different personnel. Report/ Information classes are as under:

- Operational Reports
- Performance Review Reports
- Analytical Reports
- Graphs
- Alerts
- SMS Messages
- Data Extraction Tools

Total 54 readymade reports, 5 performance review reports, 12 analytical reports, 15 types of SMS messages, 5 graphs, 10 alert messages are readymade available in the application. SMS messages are available in regional language, also.

The **operational reports** help service providing organization to asist their employees to carry out their job more effectively. For example, AI technicians can produce information on daily basis on animals to be examined for pregnancy diagnosis, animals expected to calve this week, animals that have been inseminated more than three times etc.. Such information helps them do their job more effectively. These reports were described earlier.

The **review reports** help service providing organisations to evaluate the performance of their employees. For example, supervisors and managers can produce performance reports of all inseminators on certain key parameters such as: number of inseminations carried out, number of animals followed, conception rates, calves borne etc..

The review reports can also assist service providing organisations to evaluate the effectiveness of the products they use. For example, an AI-service providing organization from the review reports can know the fertility of bulls whose semen being used. They can withdraw semen doses of bulls having lower fertility. From breeding values for fertility of bulls, they can select bulls with higher fertility. The review reports for different activities were described earlier.

13.1   Analytical Reports

Apart from operational and review reports, the INAPH Application produces **Analytical Reports** that help in building knowledge about productivity and health. It produces comparative performance reports on many fertility and production parameters, which help in identifying factors that influence fertility and productivity. It produces comprehensive performance reports for individual animal, individual village and individual bull as well as comparative performance reports for villages and bulls. The INAPH Application produces the following Analytical Reports:

1. Individual Cow report
2. Herd Status Report – (Individual animal wise for all animals)
3. Village Status Report – Reproduction
4. Village Status Report – Production
5. Village Status Report – Completed Lactation
6. Reproductive Performance of Bulls – General doses
7. Reproductive Performance of Bulls – Test doses
8. Test dose Analysis
9. Bull wise Milk Production and Milk Component Analysis
10. Nominated Mating Report
11. Bull wise Breeding Values
12. Bull wise Typing Report

13.1.1   **Individual Cow Report:** The Individual Cow Report provides complete life time reproduction and production data of an animal, which includes complete pedigree data, current lactation and life time milk production and milk component data, latest breeding values on milk yield and milk components, monthly milk yield and milk component records of

current lactation including a lactation curve, and past complete reproduction and production records lactation wise.

13.1.2   **Herd Status Report:** The Herd Status Report provides complete details of all existing heifers and cows in the selected village one in each row. The reports gives the current status of each animal (in terms of whether it is heifer, heifer inseminated, heifer pregnant, cow calved, cow in milk, cow inseminated, cow pregnant, cow calved, cow dry, cow dry and pregnant, cow dry non pregnant etc.) and then the history of the current lactation in terms of days bred first time, service period, lactation days, lactation yield and milk components, dry period etc. This report gives comparative performance of all animals in a village.

13.1.3   **Village Status - Reproduction**: For the selected village, this report groups cows in four categories namely: pre-breeding, active breeding, pregnant and dry, and compares these figures with those of three months back, six month back and 12 months back. In each category, the performance is judged on one or two key parameters. For example in pre-breeding category the performance is judged on the basis of percentage of pre-breeding cows more than 90 days. In case of active breeding three parameters are calculated: average first bred days, percentage of cows first bred greater than 90 days and percentage of active breeding cows not pregnant and active breeding days more than 150 days. For pregnant cows, three parameters are calculated: percentage of cows conceived with first insemination, average number of inseminations per conception and average service period.

Heifers are however grouped in three categories: pre-breeding, active breeding, and pregnant. The parameters used are also slightly different than those for cows. For pre-breeding the parameter calculated is average pre-breeding age. For active breeding, two parameters are calculated: average first bred age and percentage of first bred heifers more than 24 months. For pregnant heifers two parameters are calculated: percentage first service conception and average number of services per conception. Like cows here also the performance are compared with those three months back, six months back and 12 months back.

13.1.4   **Village Status – Production:** This report gives details of average productivity of cows under milk recording in terms of milk and milk component yields and compares the current yields with those three months back, six month back and one year back. It also gives monthly values for last twelve months.

13.1.5   **Village Status Report – Completed Lactation:** The report compares average lactation performance in terms of yield and milk components of the selected village with average of all villages of district of the selected village and average of all villages of state of the selected village. The comparison of performance of the selected village with respect to that of its district and its state is also depicted in the form of charts.

13.1.6   **Reproductive Performance of Bulls – general doses:** This report provides bull wise details of semen doses used, conception rate, calves born – males and females, abortion percentages, calving ease type percentages and percentages of genetic defects observed in calves. Semen doses used and calves born are given for selected month, year and cumulative and conception rates are given for the year and overall since inception.

13.1.7   **Reproductive performance of Bulls – test doses**: The details in this report are exactly the same as that produced under Reproductive Performance of Bulls – general doses except that in this report the performance details are with respect to only test doses of bulls put under progeny testing.

13.1.8   **Test Dose Analysis**: This report gives a snap shot of bull wise test doses used, daughters born, daughters inseminated, daughters calved, daughters first milk recorded and daughters completed recording.

13.1.9   **Bull wise Milk Production and Milk Component analysis**: This report provides bulls wise details of their daughter performance related to lactation yield and milk components.

13.1.10   **Nominated Mating Report**: The report provides the details of nominated mating carried out under a progeny testing programme. The Report helps to keep tract about identified female animals inseminated for nominated mating, number of female animals got pregnant, number of female animals calved, number of male calves born and number of males collected after disease testing.

13.1.11   **Bull wise Breeding values:** After breeding values are estimated and they are uploaded in the database, one can produce this report. This report gives breeding values for milk and milk component traits and reliability estimates for milk yield trait.

13.1.12   **Bull wise Typing details:** This report provides bull wise average type score of daughter and breeding value for each of 16 linear type traits.

14   SMS Application

The **SMS Application** interacts with the central data base and sends SMS messages to farmers' mobile. At the time of registration of animal, information on mobile number is captured. The following SMS messages are sent in local language to farmers:

1. Animal Expected to come in heat during <DATE1> to <DATE2>
2. Animal Non-pregnant, open period <N> months
3. Heifer Non-pregnant, Age <N> months.
4. Animal due for PD, inseminated on <DATE>.
5. Animal expected to calve during next week.
6. Animal due for milk Recording
7. Abnormal variation in milk production
8. Animal due for dry-off, <N> months pregnancy.
9. Lactation Record: <Animal ID>, <Total Yld>, <Stnd Yld> etc.
10 Milk Component Testing: <AnimalID>,<SampleID>,<Fat%>, etc.
11. <DISEASE> outbreak recorded in <VILLAGE>
12. <VILLAGE> due for Mass Vaccination against <DISEASE> on <DATE>
13. <ANIMAL> due for Vaccination against <DISEASE> on <DATE>.
14. <VILLAGE> due for Mass De-worming on <DATE>.
15. <ANIMAL> due for De-worming on <DATE>.

15   Breeding Value Estimation

The breeding value estimation procedure is divided into three steps: generating a pedigree and a data file from INAPH database; estimation of breeding values of bulls and daughters using third party breeding value estimation software, and updating estimated breeding values in the main INAPH database.
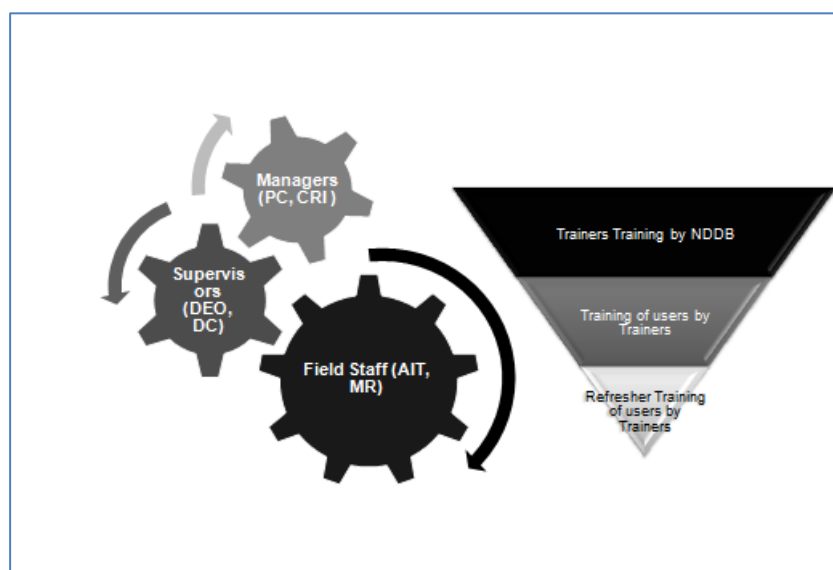
15.1   Generation a Pedigree and a data file: INAPH Application provides functionality by which both data and pedigree files are generated as text files having fixed column width separated by space. Animals flagged for wrong parentage in the animal master are not considered for processing.

15.1.1 **Data file:** This data file will contain lactation wise and trait wise records of all female animals. The Data File has primarily three groups of columns: (i) General, (ii) Factors, (iii) variables. General data include animal ID, sire ID, dam ID and lactation number. Factor Columns are selected from list box; the options include:(i)Age at calving in months, (ii)lactation length in days, (iii) gestation period in days, (iv) dry period in days for second and subsequent lactations, (v) inter-calving period for second and subsequent lactations, (vi) sex of calf (1 male, 2 female), (vii) Exotic blood% (0% - 1, <12.5 – 2, 12.5% - 3, 25% - 4, 37.5% - 5, 50% - 6, 62.5% - 7, 75% - 8, 87.5% - 9, > 87.5% - 10, 100% - 11.), and Herd-Year-Season factor – which are generated through an interactive process. One or more variables are selected from the list box. Variables are basically traits such as 305 day lactation yield, 305 day fat%, 305 day fat yield, 305 day protein %, 305 day protein yield etc.

15.1.2 **Pedigree file:** The Pedigree file has three columns: Animal ID, Sire ID and Dam ID. Each row is for one animal – daughter, sire, dam etc. In case, an animal's sire/dam is not known, a zero is put in the respective column. The identification of all animals is re-generated in such a way that the animal ID number is larger than ID number of both Sire and Dam and Dam ID number is larger than sire ID. Mapping of this renumbering is stored and used later on while updating the breeding value in the database.

15.2 **Breeding value estimation:** Using the pedigree file and the data file, breeding values are estimated using a third party software, which produces breeding values and reliability for individual animal both for bulls and for female animals for each trait.

15.3 **Reading of breeding value estimation file:** The INAPH Application provides a functionality, which reads the output generated file produced through third party breeding value estimation software and push those values in the main database against respective bull or female animal.

16 **User Agreement for INAPH:** Any new User will have to sign an Agreement for the Use of INAPH. The Agreement briefly describes the INAPH Application and what it offers, what helps NDDB will provide to the Application User, what are the responsibilities of and assurances expected from the Application User, and What NDDB will charge for the use of the application etc..
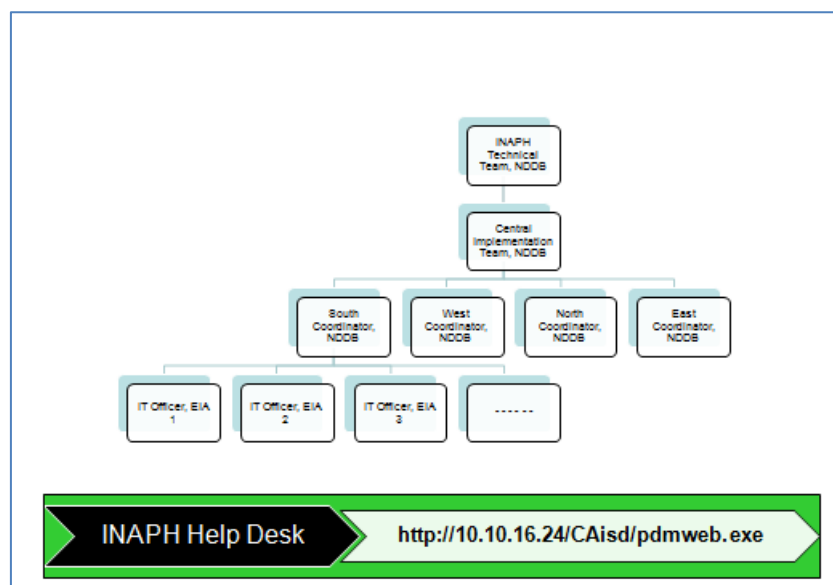
17   **Training and Capacity Building**

Training is key component in implementation of INAPH in an organization. NDDB provides three types of training programs.

- **Training of field staff (AI Technicians, Milk Recorders etc.):** This training includes use of application for transaction recording, generation of operational reports, Alerts etc.

- **Training of Supervisors & Middle level managers.:** This training includes complete understanding of the application, including technical aspects, communication infrastructure, Application deployment, trouble shooting etc.

- **Training to Senior Managers & Ananlysts.:** This training focuses on generation of information from different INAPH resources and their use in analysis. This training also includes export and import of data to and from INAPH database to other standard formats for local analysis, if any.

- NDDB also arranges training for trainers and refresher training programs on regular intervals.

18 **Implementation Support**

NDDB provides INAPH implementation support to all service providers in a systematic manner. It has set up an INAPH Help Desk. The INAPH Help desk is available to all concerned for logging the requests and tracking the resolution in progress. The following arrangement is made by NDDB to help all users.

- Each implementing agency is to identify one IT officer to coordinate with the NDDB INAPH implementation team to resolve issues, if any.
- INAPH coordinators have been placed by NDDB in all 4 regions in the country. Number of coordinators in a region are placed depending upon the number of projects in that region.
- A central INAPH implementation team at Anand takes care of all issues escalated by regional coordinators in consultation with domain professionals.
- A technical team at Anand takes care of all IT and software related technical issues escalated by regional managers.